EXHIBIT N

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Cisco Systems, Inc.
Petitioner

v.

Capella Photonics, Inc.
Patent Owner

Patent No. RE42,678
Filing Date: June 15, 2010
Reissue Date: September 6, 2011

Title: RECONFIGURABLE OPTICAL ADD-DROP MULTIPLEXERS WITH SERVO CONTROL AND DYNAMIC SPECTRAL POWER MANAGEMENT CAPABILITIES

Inter Partes Review No. 2014–01276

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List of Exhibits Cited in this Petition

Exhibit 1001:U.S. Reissued Patent No. RE42,678 to Wilde et al. (“ ‘678 patent”)

Exhibit 1002: File History of U.S. Patent No. RE42,678 to Wilde et al. (“ ‘678 File History”)

Exhibit 1003: U.S. Patent No. 6,498,872 to Bouevitch et al. (“Bouevitch”)

Exhibit 1004: U.S. Patent No. 6,798,941 to Smith et al. (“Smith Patent,” or “Smith”)

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Exhibit 1009: U.S. Patent No. 6,253,001 to Hoen (“Hoen”)

Exhibit 1010: U.S. Patent No. 5,661,591 to Lin at al. (“Lin”)

Exhibit 1011: Doerr et al., An Automatic 40-Wavelength Channelized Equalizer, IEEE Photonics Technology Letters, Vol., 12, No. 9, (Sept. 2000)

Exhibit 1012: U.S. Patent No. 5,936,752 to Bishop et al. (“Bishop ‘752”)

Exhibit 1013: Excerpt from New World English Dictionary ("servo” and “servomechanism”)

Exhibit 1014: Excerpt from Collins English Dictionary - Complete & Unabridged 10th Edition. HarperCollins Publishers. http://dictionary.reference.com/browse/feedback (accessed: May 07, 2014) (“feedback”)

Exhibit 1015: Ford et al., *Wavelength Add–Drop Switching Using Tilting Micromirrors*, Journal of Lightwave Technology, Vol. 17, No. 5 (May 1999) (“Ford”)

Exhibit 1016: U.S. Patent No. 6,069,719 to Mizrahi ("Mizrahi")

Exhibit 1017: U.S. Patent No. 6,204,946 to Aksyuk et al. ("Aksyuk")

Exhibit 1018: U.S. Patent Application Publication No. US 2002/0105692 to Lauder et al. ("Lauder")

Exhibit 1019: Giles et al., Reconfigurable 16-Channel WDM DROP Module Using Silicon MEMS Optical Switches, IEEE Photonics Technology Letters, Vol. 11, No. 1, (Jan. 1999) ("Giles 16-Channel WDM DROP Module")

Exhibit 1020: Andrew S. Dewa, and John W. Orcutt, *Development of a silicon 2-axis micro-mirror for optical cross-connect*, Technical Digest of the Solid State Sensor and Actuator Workshop, Hilton Head Island, SC, June 4-8, 2000) at pp. 93-96 ("Dewa")

Exhibit 1021: U.S. Patent No. 6,011,884 to Dueck et al. ("Dueck")

Exhibit 1022: U.S. Patent No. 6,243 ,507 to Goldstein et al. ("Goldstein '507")

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Exhibit 1024: U.S. Patent No. 6,256,430 to Jin, et al. ("Jin")

Exhibit 1025: U.S. Patent No. 6,631,222 to Wagener et al. ("Wagener")

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Exhibit 1030: James A. Walker et al., *Fabrication of a Mechanical Antireflection Switch for Fiber-to-the-Home Systems*, 5 J. Microelectromechanical Sys. 45, 46-47, Fig. 3 (1996) ("Walker").

Exhibit 1031: U.S. Patent No. 5,414,540 to Patel et al. ("Patel")

Exhibit 1032: Borella, et al., Optical Components for WDM Lightwave Networks, Proceedings of the IEEE, Vol. 85, NO. 8, August 1997 ("Borella")

Exhibit 1033: U.S. Patent No. 6,928,244 to Goldstein et al. ("Goldstein '244")

Exhibit 1034: Steffen Kurth et al., Silicon mirrors and Micromirror Arrays for Spatial Laser Beam Modulation, Sensors and Actuators, A 66, July 1998

Exhibit 1035: C. Randy Giles and Magaly Spector, *The Wavelength Add/Drop Multiplexer for Lightwave Communication Networks*, Bell Labs Technical Journal, (Jan.-Mar. 1999) ("Giles and Spector")

Exhibit 1036: U.S. Patent No. 5,872,880 to Maynard (the "Maynard patent")

Exhibit 1037: R.E. Wagner and W.J. Tomlinson, *Coupling Efficiency of Optics in Single-Mode Fiber Components*, Applied Optics, Vol. 21, No. 15, pp. 2671-2688 (August 1982)

Exhibit 1038: Excerpts from Born et al., PRINCIPLES OF OPTICS, (6th Ed., Pergammon Press 1984)

Exhibit 1039: Excerpts from Shigeru Kawai, HANDBOOK OF OPTICAL Interconnects (2005)

Exhibit 1040: U.S. Patent No. 6,625,350 to Kikuchi (the "Kikuchi patent")

Exhibit 1041: Joseph E. Ford & James A. Walker, *Dynamic Spectral Power Equalization Using Micro-Opto-Mechanics*, IEEE Photonics Technology Newsletter, Vol. 10, No. 10, (Oct. 1998) ("Ford & Walker, Spectral Power Equalization")

Exhibit 1042: U.S. Patent No. 5,048,912 to Kunikane et al. ("Kunikane patent")

Exhibit 1043: U.S. Patent No. 5,315,431 to Masuda et al. ("Masuda patent")

Exhibit 1044: S. Yuan, and N. A. Riza, *General formula for coupling loss characterization of single mode fiber collimators by use of gradient index rod lenses*, Appl. Opt. Vol. 38, No. 10, at 3214-3222, (1999)

Exhibit 1045: Ming C. Wu, *Micromachining for Optical and Optoelectronic Systems*, Proc. IEEE, Vol. 85, No. 11, at 1833-56 (Nov. 1997) ("Wu, Micromachining")

Exhibit 1046: Sir Isaac Newton, *Opticks or a treatise of the reflections, refractions, and inflections and colors of light* (1730)

Exhibit 1047: Chikama et al., *Photonic Networking Using Optical Add Drop Multiplexers and Optical Cross-Connects*, Fujitsu Sco. Tech. J., 35, 1, pp. 46-55 (July 1999)

Exhibit 1048: Richard S. Muller & Kam Y. Lau, *Surface-Micromachined Microoptical Elements and Systems*, Proceedings of the IEEE, Col. 86, No. 8 (August 1998)

I. INTRODUCTION

Petitioner Cisco Systems, Inc. requests *inter partes* review under 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42, of claims 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65 (the "Petitioned Claims") of U.S. Patent No. RE42,678 (Ex. 1001) ("the '678 patent"), assigned on its face to Capella Photonics, Inc.

In prosecuting its reissue patent, Patentee admitted that its original claim set was overbroad and invalid in light of U.S. Patent No. 6,498,872 (Ex. 1003) ("Bouevitch"). To fix this claim drafting mistake and to distinguish over Bouevitch, Patentee made two amendments to most of the patent's independent claims. But those amendments merely swapped one known component for another known component. As described in the body of this petition, those amendments swapped one known type of mirror for another known type of mirror.

While the Patentee's reissue amendments may have addressed the novelty issues in light of Bouevitch, those amendments do not overcome obviousness. Bouevitch in combination with the prior art described in the body of this petition renders the Petitioned Claims invalid as obvious.

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(A)(1)

A. Real Party-In-Interest under 37 C.F.R. § 42.8(b)(1)

Petitioner Cisco Systems, Inc. is the real party-in-interest for this petition.

B. Related Matters under 37 C.F.R. § 42.8(b)(2)

Petitioner has filed petition IPR-2014-01166 on a related patent to the '678;

U.S. RE42,368. The '678 Patent is asserted against Cisco in an on-going patent lawsuit brought by Patent Owner in *Capella Photonics, Inc. v. Cisco Systems, Inc.*, Civil Action No. 3:14-CV-03348-NC ("California litigation"), pending in the Northern District of California. Claims 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65 of the '678 patent are asserted in the California litigation.

C. Lead and Back-Up Counsel under 37 C.F.R. § 42.8(b)(3)

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D. Service Information

As identified in the attached Certificate of Service, a copy of the present petition, in its entirety, including all Exhibits and a power of attorney, is being served by USPS EXPRESS MAIL, costs prepaid, to the address of the attorney or agent of record for the '678 patent: Barry Young, Law Offices of Barry N. Young, P.O. Box 61197, Palo Alto, CA 94306. Petitioner may be served at the lead counsel address provided in Section I.C. of this Petition.

E. Power of Attorney

A power of attorney is being filed concurrently with the designation of

counsel in accordance with 37 C.F.R, § 42.10(b).

III. PAYMENT OF FEES - 37 C.F.R. § 42.103

This petition for *inter partes* review requests review of 24 claims of the '678 patent and is accompanied by a request fee payment of $27,400. *See* 37 C.F.R. § 42.15. Thus, this petition meets the fee requirements under 35 U.S.C. § 312(a)(1).

IV. REQUIREMENTS FOR *INTER PARTES* REVIEW UNDER 37 C.F.R. § 42.104

A. Grounds for Standing under 37 C.F.R. § 42.104(a)

Petitioner certifies that the '678 patent is eligible for *inter partes* review and further certifies that Petitioner is not barred or otherwise estopped from requesting *inter partes* review challenging the identified claims on the grounds identified within the present petition.

B. Identification of Challenge under 37 C.F.R. § 42.104(b) and Statement of Precise Relief Requested

Petitioner requests *inter partes* review of claims 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65 of the '678 patent under the statutory grounds set forth in the table below. Petitioner asks that each of the claims be found unpatentable. An explanation of how claims 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65 are unpatentable is included in § VIII of this petition. Additional explanation and support for each ground of rejection is set forth in the Declaration of a technical expert, Dr. Dan Marom (Ex. 1028) ("Marom Decl.").

Ground	'678 Patent Claims	Basis for Challenge

Ground	'678 Patent Claims	Basis for Challenge
1	1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65	Obvious under § 103(a) by Bouevitch in view of Smith.
2	1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65	Obvious under § 103(a) by Bouevitch in view of Smith further in view of Lin.
3	17, 29, and 53	Obvious under § 103(a) by Bouevitch in view of Smith in further view of Dueck.
4	17, 29, and 53	Obvious under § 103(a) by Bouevitch in view of Smith and Lin in further view of Dueck.

The references relied upon in the grounds 1, 2, 3 and 4 set forth above qualify as prior art under 35 U.S.C., § 102(e) or (b).

This Petition and the Declaration of Dan Marom, submitted herewith, cite additional prior art materials to provide background of the relevant technology and to explain why one of skill in the art would combine the cited references.

C. Threshold Requirement for *Inter Partes* Review 37 C.F.R. § 42.108(c)

Inter partes review of claims 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65 should be instituted because this Petition establishes a reasonable likelihood that Petitioner will prevail with respect to at least one of the claims challenged. *See* 35 U.S.C. § 314(a). Each limitation of each challenged claim is disclosed by the prior art and/or obvious in light of that art.

V. BACKGROUND OF TECHNOLOGY RELATED TO THE '678 PATENT

Fiber-optic communication uses light to carry information over optical fibers. Originally, fiber-optic systems used one data channel per fiber. To increase the number of channels carried by a single fiber, wavelength division multiplexing ("WDM") was developed. WDM is a type of optical communication that uses different wavelengths of light to carry different channels of data. WDM combines (multiplexes) multiple individual channels onto a single fiber of an optical network. WDM was known before the '678's priority date. (E.g., Ex. 1015, 904.)

At different points in a fiber network, some of the individual channels may be extracted (dropped) from the fiber, for example when those channels are directed locally and need not be passed further down the fiber network. And at these network points, other channels may also be added into the fiber for transmission onward to other portions of the network. To handle this add/drop process, optical add-drop multiplexers (OADMs) were developed. OADMs are used to insert channels onto, pass along, and drop channels from an optical fiber without disrupting the overall traffic flow on the fiber. ('678 Pat., 1:51-58.) OADMs were known long before the '678 priority date. (E.g., Ex. 1015, 904.)

(Re)configurable OADMs are referred to as "ROADMs" or "COADMs," which are controllable to dynamically select which wavelengths to add, drop, or pass through. (Bouevitch, Abstract; Ex. 1019, 64.) These types of devices were

known in the art prior to the '678 priority date. (Marom Decl., ¶ 30.)

ROADMs operate by separating the input light beam into individual beams—each beam corresponding to an individual channel. Each input channel/beam is individually routed by a beam-steering system to a chosen output port of the ROADM. For example, a first channel can be steered so that it is switched from an "input" port to an "output" port. Channels switched to the "output" port are passed along the network. At the same time, a second channel can be switched to a "drop" port and removed from the main fiber. The ROADM could also add a new channel to the main fiber through the "add" port to replace the dropped channel. These add/drop techniques were known prior to the '678 priority date. (Marom Decl., ¶ 29; Bouevitch, 5:15-38; Ex. 1016, 1:55-2:45; Ex. 1017, 1:56-67.)

In addition to routing channels, ROADMS may also be used to control the power of the individual channels. Power control is often performed by steering individual beams slightly away from the target port such that the misalignment reduces the amount of the channel's power that enters the port. This misalignment power control technique in ROADMs was known prior to the '678 priority date. (*See e.g.*, Marom Decl., ¶¶ 36, 44, 63; Ex. 1006, 2:9-21.)

ROADMs use wavelength selective routers (WSRs) to perform switching and power control. (*See, e.g.*, Ex. 1026, 10:64-11:29.) WSRs are also referred to

as wavelength selective switches (WSSs). (*See*, *e.g.*, Ex. 1027, Fig. 10 Marom Decl., ¶ 32-33.) As of the '678 priority date, WSRs/WSSs were known. (*See, e.g., id.,* Ex. 1026, Abstract, 4:15-25; Ex. 1027, Fig. 10; Ex. 1032 at 1292, 1300.)

The embodiment of WSRs relevant to this petition steers light beams using small tilting mirrors, sometimes called MEMS, which stands for Micro ElectroMechanical Systems. (Marom Decl., ¶¶ 37-38.) Prior-art WSRs could tilt the individual mirrors using analog voltage control. (*Id.*) The tilt allows reflected beams to be aimed at selected ports. (*Id.*) MEMS mirrors could be tilted in one or two axes, and were known in the art prior to the priority date for the '678's patent. (Marom Decl., ¶38.)

VI. SUMMARY OF THE '678 PATENT

The '678 patent originally issued as U.S. Patent No. 6,625,346 and then reissued as RE39,397. According to the Patentee, this original '397 patent included claims that were invalid over Bouevitch. The Patentee expressly acknowledged its claiming mistake and identified the two elements that it alleged needed to be added to its claims to support patentability–(1) mirror control in two-dimensions; and (2) the mirror's use for power control:

> ***At least one error upon which reissue is based is described as follows: Claim 1 is deemed to be too broad and invalid in view of U.S. Patent No. 6,498,872 to Bouevitch*** and further in view of one or more of U.S. Patent No. 6,567,574 to Ma, U.S. Patent No. 6,256,430 to Jin, or U.S. Patent No.

> 6,631,222 to Wagener ***by failing to include limitations regarding the spatial array of beam deflecting elements being individually and continuously controllable in two dimensions to control the power of the spectral channels*** reflected to selected output ports, as indicated by the amendments to Claim 1 in the Preliminary Amendments…. (Ex. 1002, 104 (exhibit pagination); emphasis added.)

In its efforts to distinguish over Bouevitch, Patentee's first amendment specified that the beam-deflecting elements must be controllable in two dimensions rather than in just one. That amendment corresponds to a mirror tilting in two axes rather than one. As for the second amendment, Patent Owner added a use clause stating that the beam-deflecting elements could be used to control the power. As explained in the claim construction section (§ VII, below), use clauses are not limiting, and have no impact on an invalidity analysis. Claim 1 as amended, with the amendments underlined and deletions struck through, is shown in Table 1.

Table 1	
1	A wavelength-separating-routing apparatus, comprising:
1a	multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports;
1b	a wavelength-separator, for separating said multi-wavelength optical signal from said input port into multiple spectral channels;
1c	a beam-focuser, for focusing said spectral channels into corresponding spectral spots; and
1d	a spatial array of channel micromirrors positioned such that each channel

	micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect ~~said~~ corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports.

The Patentee made almost identical amendments to claims 44 and 61.

Through the Patentee's admissions about Bouevitch, the Patentee also admitted that Bouevitch disclosed all the elements of at least claim 1 (including the preamble), except for 2-axis mirrors. The Patentee first admitted that Bouevitch anticipated the pre-reissue version of claim 1 in the original '397 patent. Following that, the only substantive amendments the Patentee added to the claim were the use of individual ("corresponding") 2-axis mirrors for switching channels to ports, and the mirrors' intended use for power control. Because the intended use language is not limiting, as discussed in the next section, the Patentee admitted that Bouevitch disclosed all limitations but for 2-axis mirrors. (*See* MPEP § 2217 ("admissions by the patent owner in the record as to matters affecting patentability may be utilized during a reexamination") (citing 37 CFR 1.104(c)(3)).)

VII. CLAIM CONSTRUCTION UNDER 37 C.F.R. § 42.104(B)(3)

A. Legal Overview

A claim subject to *inter partes* review (IPR) is given its "broadest reasonable construction in light of the specification of the patent in which it appears" ("BRI").

37 C.F.R. § 42.100(b). Except as expressly set out below, Petitioner construes the language of the claims to have their plain and ordinary meaning.

B. "To control the power…," "to reflect [its] [corresponding] … spectral channels," "wherein each output port carries a single one of said spectral channels," "whereby said pass-through port receives a subset of said spectral channels," and "for maintaining a predetermined coupling…" (Claims 1–19, 21–30, 44–53)

Each of the above terms is a mere statement of intended use and is not limiting for apparatus claims 1–19, 21–30, and 44–53. The Federal Circuit stated that "apparatus claims cover what a device *is*, not what a device *does*." *Hewlett–Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1468 (Fed. Cir. 1990). "An intended use or purpose usually will not limit the scope of the claim because such statements usually do no more than define a context in which the invention operates." *Boehringer Ingelheim Vetmedica, Inc. v. Schering-Plough Corp.*, 320 F.3d 1339, 1345 (Fed. Cir. 2003); *see also Paragon Solutions, LLC v. Timex Corp.*, 566 F.3d 1075 (Fed. Cir. 2009); MPEP §§ 2114, 1414.)

The BPAI has also addressed use clauses. In *Ex parte Kearney,* the BPAI stated that use clauses need not be considered when evaluating the validity of a claim. *Ex parte Kearney*, 2012 Pat. App. LEXIS 2675, at *6 (BPAI 2012) ("our reviewing court has held that the absence of a disclosure relating to function does not defeat a finding of anticipation if all the claimed structural limitations are

found in the reference.")

The above phrases are non-functional use clauses because they say nothing about the structure of the apparatus. Unlike claim limitations reciting "***configurable to*** [perform a function]," which might reflect the configuration of a physical part of the apparatus, the terms at issue in the '678 patent say nothing about what the apparatus is. Instead, the clauses speak only to what it might do. Petitioner asks that the Board find the above phrases non-limiting.

C. "Continuously controllable/[controlling]" (Claims 1–19, 44–67)

The BRI for "continuously controllable" in light of the specification is "under analog control." This BRI is consistent with the use of the term in the specification, which describes how "analog" means are used to effect continuous control of the mirrors. The patent explains that "[a] distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion…of each channel micromirror is under ***analog control*** such that its pivoting angle can be ***continuously adjusted***" ('678 Pat., 4:7-11 (emphasis added).) Another passage in the specification states that "[w]hat is important is that the pivoting (or rotational) motion of each channel micromirror be individually ***controllable in an analog manner, whereby the pivoting angle can be continuously adjusted*** so as to enable the channel micromirror to scan a spectral channel across all possible output ports." ('678 Pat., 9:9-14; emphasis added). Yet

another passage states that "channel micromirrors 103 are individually controllable and movable, e.g., pivotable (or rotatable) under analog (or continuous) control." (*Id*., 7:6-8).

D. "Servo-control assembly" and "servo-based" (Claims 2-4, 21-43, and 45-46)

The BRIs for the terms "servo control assembly" and "servo-based" in light of the specification are "feedback-based control assembly" and "feedback-based control." These definitions are consistent with the use of the term in the specification, which equates servo control with use of a feedback loop. For example, when describing its "servo control," the '678 patent teaches a spectral monitor that provides "feedback" control for the mirrors. "The servo-control assembly 440 further includes a processing unit 470, in communication with the spectral monitor 460 and the channel micromirrors 430 of the WSR apparatus 410. The processing unit 470 uses the power measurements from the spectral monitor 460 ***to provide feedback control*** of the channel micromirrors 430." (*Id*., 11:18-24; emphasis added.) In another passage, the '678 patent states that the servo-control assembly "serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micro mirrors on an individual basis, so as to maintain a predetermined coupling efficiency of each spectral channel." (*Id*., 4:45-52.)

Moreover, in the figure that the '678 patent labels "servo-control assembly," the '678 patent shows a controller which takes measurements of the output power and moves the mirrors to further adjust that power—a typical feedback loop. (*Id.*, Fig. 4a, Ex. 1014.) Also confirming this BRI, the feedback-based control described in the '678 patent achieves the same goals that the patent ascribes to its "servo-control assembly"—dynamic adjustment to account for changing conditions, such as the possible changes in alignment of the parts within the device or differing gains of other devices. ('678 Pat., 4:56-67.)

Petitioner is aware that a "servo" can sometimes refer to a servomotor, which is a type of actuator. But that is not what the patent is referring to here with its use of servo in the context of a "servo-control assembly." Should Capella attempt to change the "servo-control assembly" to refer instead to some "servo"-based *actuation* mechanism (as opposed to a ***control*** mechanism), there is no support for that in the specification. The '678 patent nowhere address the details of the MEMS mirror actuation, and instead discusses "servo-control" and "servo-based" strictly in terms of the ***control*** system used to move the mirrors, not the actuation mechanism that physically moves them. (*See*, *e.g.*, '678 Pat., 4:45-, 5:5, 6:3-16, 10:62-12:49.)

E. "Spectral monitor" (Claims 3, 22, and 46)

The BRI for the term "spectral monitor" is "a device for measuring power."

This definition is consistent with the use of the term in the specification, where the use of the monitor is to measure the power of the WDM output signals. The spectral monitor is shown in Figure 4A measuring output power, and the specification describes the spectral monitor as providing power measurements as part of a feedback loop. ('678 Pat., 11:14-23 ("processing unit 470 uses the power measurements from the spectral monitor 460 to provide feedback control").) In addition, the only requirement for the spectral monitor that the patent identifies is that the monitor "be capable of detecting the power levels of spectral components in a multi-wavelength optical signal." (*Id.*, 11:58-61.) As such, another valid interpretation of "spectral monitor" is that it is "a device for measuring power spectrum."

F. "Beam-focuser" (Claims 1–67)

The BRI for the term "beam-focuser" in light of the specification is "a device that directs a beam of light to a spot." This definition is consistent with the use of the term in the specification and the claims. The Summary of the '678 patent states that the "beam-focuser focuses the spectral channels into corresponding spectral spots." ('678 Pat., 3:63-64.) The specification also explains that the beams of light are "focused by the focusing lens 102 into a spatial array of distinct spectral spots (not shown in FIG. lA) in a one-to-one correspondence." (*Id.*, 6:65-7:5.) The MEMS mirrors are in turn "positioned in accordance with the

spatial array formed by the spectral spots, such that each channel micromirror receives one of the spectral channels." (*Id*.) Claim 1 confirms this BRI, saying that the beam focuser is "for focusing said spectral channels into corresponding spectral spots."

Capella may attempt to narrow "beam-focuser" to a particular one of the embodiments in the '678 patent. For example, one embodiment of a "beam focuser" in the patent corresponds to element 103 in Fig. 3, which depicts a lens focusing light onto a MEMS mirror array. However, the specification also notes that the "focuser" has a broader meaning than simply a lens, and instead, "[t]he beam-focuser may be a single lens, an assembly of lenses, or other beam-focusing means known in the art." ('678 Pat., 4:20-22.) Thus, the BRI of "beam-focuser" covers any device capable of directing a beam of light to a spot.

G. [Controlling] "in two dimensions" (Claims 61–67)

The BRI for the term "in two dimensions" in light of the specification is "in two axes." As claim 61 states, the "beam-deflecting elements" are controlled "in two dimensions." The '678 patent consistently describes these beam-deflecting elements as various types of mirrors which are rotated around the two axes in which the mirrors tilt to deflect light. The specification states, for example, that the beam-deflecting elements "may be pivoted about one or two axes." ('678 Pat., 4:25-26, Abstract.) The specification also describes certain embodiments that use

two-dimensional arrays of input and output ports. For these embodiments, the specification describes that the mirrors are required to tilt along two axes ("biaxially") to switch the beams between the ports. (*Id*., 4:25-29.) And further, the '678 patent explains how to control power by tilting the mirrors in two axes. (*Id*., 16:36-51 (describing the combined use of major and minor "tilt axes" for power control & switching).)

VIII. CLAIMS 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, AND 61-65 OF THE '678 PATENT ARE UNPATENTABLE

The Petitioned Claims are obvious over Bouevitch in view of Smith (for Ground 1), and also further in view of Lin (for Ground 2). Claims 17, 29, and 53 are also obvious under Grounds 1 or 2 in further view of Dueck (per Grounds 3 & 4). Petitioner provides below (1) an overview of the status of Bouevitch, Smith, Lin and Dueck as prior art, (2) a general description of Bouevitch and Smith, (3) motivations to combine these references; and (4) a description of how these references disclose each Petitioned Claim on an element-by-element basis.

A. Bouevitch, Smith, Lin and Dueck are all prior art to the '678 patent

Bouevitch and Smith both qualify as prior art under 35 U.S.C. § 102(e) (pre-AIA), because each reference is a patent that issued from an application filed in the United States prior to the earliest application to which the '678 patent could claim priority. The earliest facial priority date for the '678 patent is based on a

provisional application filed on March 19, 2001.

Bouevitch is entitled to a 102(e) prior art date of at least its filing date of December 5, 2000. This date is before the earliest '678 priority date.

Smith is entitled to a 102(e) prior art date of September 22, 2000, the filing date of its earliest provisional application. *See, e.g., In re Giacomini*, 612 F.3d 1380 (Fed. Cir. 2010) (holding that a 102(e) reference is prior art as of the filing date of its provisional application, if that provisional provides proper written description support for the claimed invention). The portions of the Smith Patent that Petitioner relies on for its invalidity arguments are fully supported by the Smith Provisional. (Marom Decl., ¶ 152-154.) To demonstrate proper written description as required by *In re Giacomini*, the analysis below includes citations to both the Smith Patent and the Smith Provisional. Accordingly, Smith predates the earliest '678 priority date.

Dueck is entitled to the 102(b) prior art date of its filing: Dec. 13, 1997. Dueck describes various diffraction gratings for use in WDM devices.

Lin is entitled to the 102(b) prior art date of its filing: Sept. 29, 1995. Lin describes a MEMS optical switch including continuous, analog, control of mirrors.

B. Overview of the Bouevitch Prior Art

Bouevitch explicitly discloses every element of the 4 independent claims of the '678 patent (and most dependent claims) except for the use of mirrors rotatable

in two axes. Bouevitch discloses mirrors that are rotatable in a single axis.

Bouevitch discloses a configurable optical add/drop multiplexer (COADM) that uses MEMS mirrors for routing signals and controlling power. (Bouevitch, Abstract.) By tilting its MEMS mirrors, the Bouevitch COADM switches an input spectral channel to either an output port or a drop port. (*Id.*, 14:14-15:18, Fig. 11.) The COADM can also add a new channel in place of a dropped channel. (*Id.*)

The Bouevitch COADM controls the power of its output channels by tilting beam-deflecting elements (mirrors) at varying angles to control power. The "degree of [power] attenuation is based on the degree of deflection provided by the reflector (i.e., the angle of reflection)." Bouevitch, 7:23-37.) Bouevitch refers to this power control process as Dynamic Gain Equalizer (DGE) and discloses that the DGE is used "to control the relative power levels in respective channels" of a WDM system. (*Id.*, 1:24-25.)

Bouevitch's COADM uses MEMS mirrors with 1 axis of rotation. (*E.g.*, Bouevitch, 7:23-37 (describing attenuation by tilting mirrors along one axis).)

C. Overview of the Smith Prior Art

Like Bouevitch, Smith is directed at MEMS-based COADMs for optical communications. Smith discloses a COADM that uses MEMS mirrors rotatable in one and two axes for switching and power control in WDM optical communications. (Smith Pat., Abstract.) The Smith Provisional similarly

describes "a mirror array with elements that can be rotated in an analog fashion about two orthogonal axes," with one axis for switching, and one axis for power control. (Smith Prov., p. 6.) The Smith Patent notes that the 1-axis and 2-axis mirrors are interchangeable. (Smith Pat., 17:58-67, 16:55-58.) Thus, to the extent Bouevitch does not disclose 2-axis mirrors and their intended use for power control, both the Smith Patent and the Smith Provisional each does so.

D. PHOSITA had ample motivation to combine Bouevitch with Smith, including the motivations disclosed in both references

A person having ordinary skill in the art ("PHOSITA") at the time of the '678 patent would have been an engineer or physicist with at least a Master's degree, or equivalent experience, in optics, physics, electrical engineering, or a related field, including at least three years of additional experience designing, constructing, and/or testing optical systems. (Marom Decl., ¶ 20.) To the PHOSITA, Bouevitch and Smith were combinable for purposes of establishing obviousness under 35 U.S.C. § 103(a). (Marom Decl., ¶¶ 40-48.) Most of the *KSR* obviousness rationales support combining these two references. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-421 (2007); MPEP § 2141.

First, the use of Smith's 2-axis mirrors in Bouevitch's system is a simple substitution of one known, closely-related element for another that obtains predictable results. The 1-axis mirrors of Bouevitch and the 2-axis mirrors of

Smith were known to be interchangeable. (Marom Decl., ¶¶ 40-48.) Smith expressly acknowledges this interchangeability: "in comparison to the two-axis embodiment, single axis systems may be realized using simpler, single axis MEMS arrays but suffer from increased potential for crosstalk between channels." Smith Prov., 11; Smith Pat., 18:17-18.) Smith also states that "both single and dual axis mirror arrays may be used in a variety of switching configurations, although the two-axis components are preferred." Smith Prov., 11; Smith Pat., 16:55-58; Ex. 1007, 4:17-19 (claiming a crossconnect with "an array of tiltable mirrors comprising a plurality of mirrors, each mirror being tiltable ***about at least one*** tilting axis") (emphasis added).)

Second, combining Bouevitch with Smith is nothing more than the use of known techniques to improve similar devices. PHOSITA could use the 2-axis mirrors of the Smith ROADM as a replacement for the 1-axis mirrors in the similar Bouevitch ROADM. (Marom Decl., ¶¶ 43-45.) Each reference discusses devices in the same field of fiber optic communications Bouevitch, 1:18; Smith Pat., 1:10-15; Smith Prov., 1). Each reference is directed at the same application in that field—optical switching for multi-wavelength WDM communications. (Bouevitch, Abstract; Smith Pat., Title.) Each reference discloses the same type of optical switch—a COADM. And each COADM uses the same type of WSS for switching—a MEMS-based optical add/drop multiplexer. As a result, using the

known 2-axis mirrors in the Bouevitch ROADM is nothing more than the use of known techniques to improve similar devices. (Marom Decl., ¶¶ 43-45.) And using 2-axis mirrors for power control instead of 1-axis mirrors would yield the same predictable result for power control if used in the MEMS-based switch of Bouevitch. (Marom Decl., ¶¶ 44-46.) Rotation about either 1 or 2 axes would result in controllable misalignment to alter power. (Marom Decl., ¶¶ 41, 44-46.)

Third, it would be obvious to try Smith's 2-axis mirrors in Bouevitch because 2-axis mirrors were among a small number of identified, predictable solutions, and PHOSITA had a high expectation of success with either. (Marom Decl., ¶ 46.) There are only two options for tilting MEMS mirrors: 1-axis and 2-axis mirrors. (Marom Decl., ¶ 46) Because Smith already disclosed the use of 2-axis mirrors (which were available by the '678 patent's priority date), PHOSITA would have a high expectation of success to try 2-axis mirror control in Bouevitch, both for switching and power control. (Marom Decl., ¶ 46.) And the impact of tilting in 1 or 2 axes for the steering of a light beam is entirely predictable. (*See* '678 Pat., 4:25-29 (2-axes allows 2-D steering); Marom Decl., ¶ 46.)

Fourth, Smith and Bouevitch, as well as other contemporaneous prior art, provide explicit motivations to combine the references. For example, PHOSITA would be motivated to use the 2-axis mirrors of Smith with the system of Bouevitch to reduce crosstalk in attenuation. (Smith Pat., 18:17-18; Marom Decl.,

¶¶ 47-48.) Crosstalk is reduced by performing beam misalignment in a different axis than the axis used for switching. (Marom Decl., ¶ 47; Smith Pat., 16:55-59, 18:18-25.) The PHOSITA would also be motivated to use the 2-axis mirrors of Smith with the Bouevitch COADM to increase port density. (Marom Decl., ¶ 48.) Compact, two-dimensional arrays of fiber ports can be utilized when two-axis mirrors allow beams to be steered in two dimensions to those ports. (Marom Decl., ¶ 48; Bouevitch, 2:9-21; Ex. 1007, 3:10-11; Ex. 1009, 2:1-16.)

Finally, the Patentee's admission during prosecution that claim 1 was invalid over Bouevitch "further in view of one or more of" Ma, Jin, and Wagener also confirms that one of skill in the art would have been motivated to combine Bouevitch with Petitioner's other references which are similar to Ma, Jin, and Wagener. (*See* Ex. 1002, 81-82) By admitting that claim 1 was ***invalid*** over Bouevitch "further in view of one or more of" Ma, Jin, and Wagener, the Patentee also admitted the ***combinability*** of such references. This admission is important because Smith and other references that Petitioner combines with Bouevitch here are directed at the identical technology area as Ma Jin, & Wagener—MEMS-based optical switches for WDM. (*See* Ex. 1023, 1:6-11; Ex. 1024, 1:11-20, 2:27-39); Ex. 1025, 3:20-34, 5:32-43).) Thus, the references Petitioner relies on here are also combinable.

E. Bouevitch and Smith Render Obvious All Petitioned Claims

The Petitioner identifies below how Bouevitch in view of Smith discloses each element of the Petitioned Claims, as well as element-specific motivations to combine the two references. Given the similarity of many of the Petitioned Claims, some of the explanations below refer to earlier discussions of the same or similar claims. In such cases, the prior referenced discussions are incorporated fully by reference in the later explanations.

1. Claim 1 – Grounds 1 and 2

The section addresses claim 1 first under Petitioner's Ground No. 1 of Bouevitch+Smith, and then under Ground No. 2 of Bouevitch+Smith+Lin.

(1) Claim 1- preamble

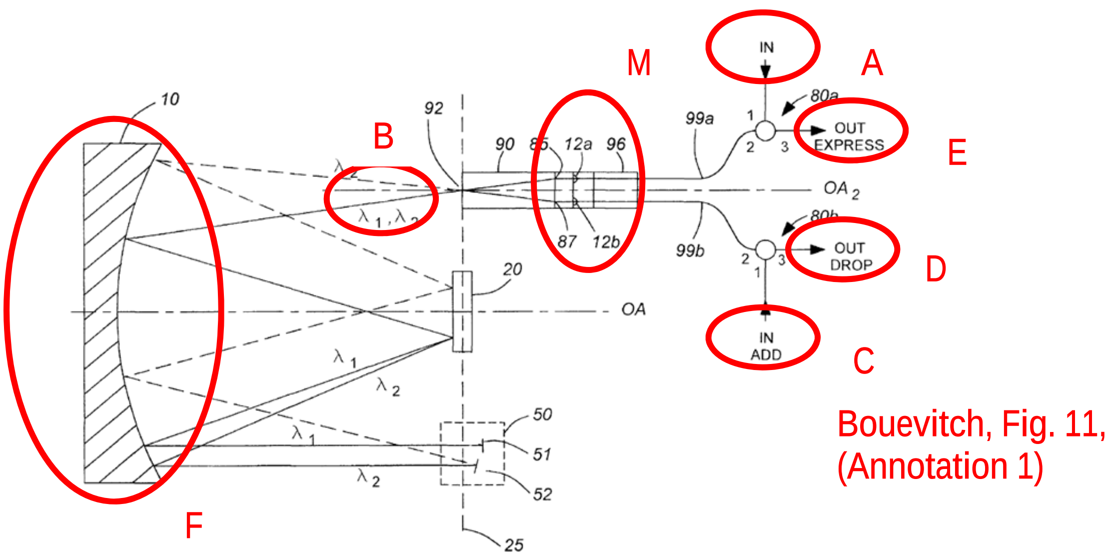
The preamble of claim 1 recites "[a] wavelength-separating-routing apparatus, comprising...." Bouevitch discloses a "Configurable Optical Add/Drop Multiplexer (COADM)" that spatially **separates** light beams **according to wavelength** and **routes** each separated sub-beam along a designated pathway (e.g., to either a pass-through or a drop port). (Bouevitch, 2:29-33, Abstract; *see also id*., 8:8–41, 5:15–20, 14:14-21, Figs. 1, 11; 3:9-63.) Thus, the COADM of Bouevitch constitutes a "wavelength-separating-routing apparatus." (Marom Decl., ¶ 50.)

(2) Claim element 1[a] – multiple fiber collimators providing input and output ports

The first limitation of claim 1 recites "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports."

The Patentee admitted in the reissue that Bouevitch discloses this element. (*See* § VI, above.) The explanation and figure below confirms that the Patentee was correct. The remainder of this section addresses element 1[a] in three sub-parts.

(1) "Multiple fiber collimators": Fig. 11-Annotation 1, below, shows two microlens fiber collimators (12a and 12b) as "M" (*see also* Bouevitch, 14:19-21):



Microlenses are one known type of fiber collimator. (*See, e.g.*, **Ex. 1040,**[0005]; Marom Decl., ¶ 51; **Ex. 1039**, Shigeru Kawai, HANDBOOK OF OPTICAL Interconnects at 327 (2005).)

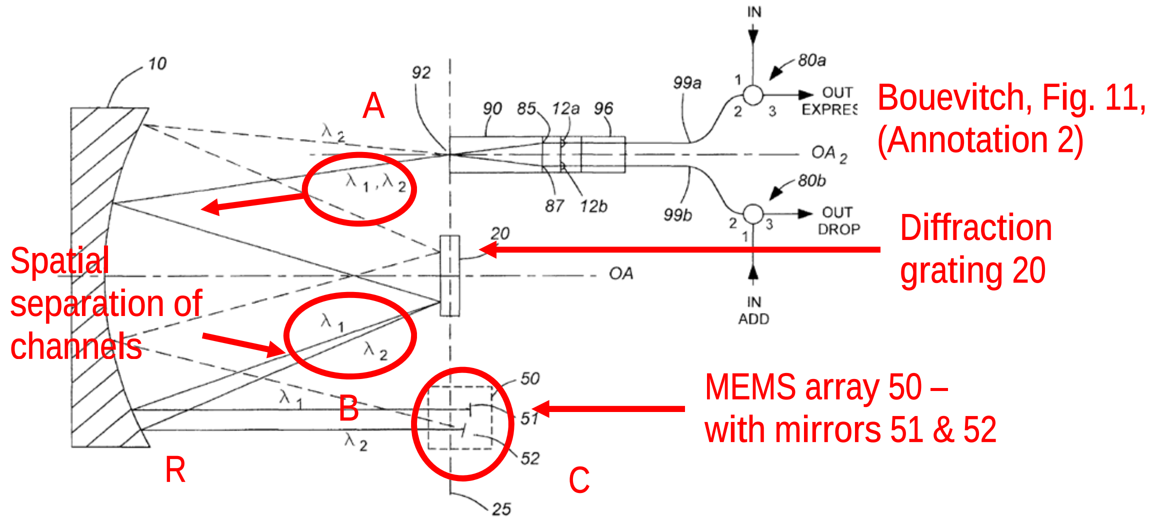
(2) "Providing an input port for a multi-wavelength optical signal": Bouevitch shows how its microlens collimators provide an input port ("A" in Fig. 11-Annotation 1, above) in conjunction with fiber waveguide 99a and circulator 80a. (Bouevitch, Fig. 11; Marom Decl., ¶ 52.) That input port receives a multi-wavelength optical signal that is "launched into" input port "IN" (annotated as "A"

in Fig. 11-Annotation 1). (Bouevitch, 14:39-42.) This signal is a multi-wavelength signal with a first spectral channel λ_1 and a second channel λ_2, as shown at annotation "B" of Fig. 11-Annotation 1, above (*Id*., 14:39-42; Marom Decl., ¶ 52).

(3) "A plurality of output ports": Bouevitch shows how its microlens collimators provide two output ports at "E" and "D" in Figure 11-Annotation 1, above. Microlens 12a provides an "Out Express" port in conjunction with waveguide 99a and circulator 80a, and microlens 12b provides an "Out Drop" port in conjunction with 99b and circulator 80b. (Bouevitch, Fig. 11; 14:14-21.)

(3) Element 1[b] – wavelength separator

Limitation 1[b] recites: "a wavelength-separator, for separating said multi-wave-length optical signal from said input port into multiple spectral channels." Diffraction grating 20 in Bouevitch Fig. 11 is such a separator. Figure 11 shows that grating 20 spatially separates combined channels $\lambda_1\lambda_2$ ("A" at Fig. 11-Annotation 2, below) from the input port 80a(1) into separated channels ("B"):



Bouevitch states, "[t]he emerging ***beam of light*** $\boldsymbol{\lambda_1\lambda_2}$, is transmitted to an upper portion of the spherical reflector 10, is reflected, and ***is incident on the diffraction grating 20, where it is spatially dispersed into two sub-beams of light carrying wavelengths*** $\boldsymbol{\lambda_1}$ ***and*** $\boldsymbol{\lambda_2}$***, respectively***." (Bouevitch, 14:48-53 (emphasis added); 8:10–22; *see also* Marom Decl., ¶ 54.))

(4) Element 1[c] – beam-focuser

The next element, 1[c], requires "a beam-focuser, for focusing said spectral channels into corresponding spectral spots." As discussed in the BRI section VII.F, the BRI for "beam focuser" is "a device that directs a beam of light to a spot."

Bouevitch—as well as Smith—discloses this beam-focuser element at reflector 10 in Figure 11. Referring to Figure 11-Annotation 2 above, reflector 10 focuses the separated spectral channels of light λ_1 and λ_2 from the points on the reflector annotated as "R" onto points on the corresponding mirrors 51 & 52 in

MEMS array 50. (Bouevitch, Figs. 11, 6a, 15:7-11, 14:14-20, 48-55; Marom Decl., ¶¶ 56-58; *see also id.*, Fig. 1, 8:46–49; *see also* Smith Pat., 12:43-50 ("A lens system 202 focuses the beams onto a MEMS mirror array"), Smith Prov., 7-8).)

Bouevitch's description of other examples of reflector 10 (examples that Bouevitch describes as "compatible with" the embodiment of Figure 11) confirms that the reflector focuses channels into spectral spots on the mirrors. (*E.g.*, Bouevitch, 11:62-63 ("grating 820 is located at the focus of" reflector 810); 10:41-47 "[t]he plurality of ***sub-beams of light*** are transmitted to the spherical reflector **610** where they are collimated and ***transmitted to the modifying means*** **150** where they are ***incident thereon as spatially separated spots corresponding to individual spectral channels***." (emphasis added); 13:65-14:1 (noting Figure 9's compatibility with "modifying means based on MEMS technology"); Marom Decl., ¶ 58.)

(5) Element 1[d] – 2-axis channel micromirrors

This final element of claim 1 (identified here as 1[d]) has 3 sub-parts. Bouevitch teaches the first two, and Smith teaches the third.

<u>(1) Micromirrors:</u> The first part of element 1[d] recites: "a spatial array of channel micromirrors positioned such that each channel micromirror receives a corresponding one of said spectral channels." Bouevitch discloses this element as MEMS array 50 with reflectors 51 and 52 shown as "C" in Fig. 11-Annotation 2, above. (Bouevitch, Fig. 11.) The PHOSITA would understand these reflectors to

be micromirrors. (Marom Decl., ¶ 60.) MEMS are often described in the prior art as arrays of "micromirrors." (*See, e.g.*, Ex 1015, Ford, Tilting Micromirrors at 904.) Bouevitch teaches positioning its micromirrors such that each receives a corresponding spectral channel dispersed by the diffraction grating. (Bouevitch, 14:53–65, 7:33–38, 10:43-51; Marom Decl., ¶ 60.)

(2) Pivotal About Two Axes, Individually / Continuously Controllable:

The second part of limitation 1[d] recites wherein each of the channel micromirrors in the array is "pivotal about two axes" and "individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports." The BRI of "continuously controllable" is "under analog control."

First, Bouevitch discloses **individual** control of each mirror in MEMS array 50 in order to direct the corresponding spectral channel into any selected output port. "[E]ach sub-beam of light…is transmitted to separate reflectors 51 and 52 of the MEMS array 50." (Bouevitch, 14:52-63; Fig. 11-Annotation 2; Marom Decl., ¶ 62.) Each reflector is individually controlled in to deflect the respective beam to either of the output ports at 80a or at 80b. (Bouevitch, 14:52-63, 10:47-51, Fig. 11-Annotation 1, elements "D" & "E"); Marom Decl., ¶ 62.)

Second, Bouevitch indicates that its reflectors are "**continuously**" controllable because (as discussed below) the amount of power the device

attenuates is a direct (e.g., analog) function of the angle of the deflector in that one axis. (Bouevitch, 7:35-37 ("The degree of attenuation is based on the degree of deflection provided by the reflector (i.e., the angle of reflection)"; Marom Decl., ¶ 63.)) Bouevitch also describes the attenuation resulting from the deflector as "variable" and based on "degree of deflection." (Bouevitch, 7:35-37, 12:59-60; Marom Decl., ¶¶ 63-54.)) Further, in addition to the disclosure of "continuously" controlling in Bouevitch, Smith also expressly discloses this element. Smith teaches continuous control of its MEMS mirrors in an analog manner, where the force used to tilt the mirrors is "approximately ***linearly*** proportional to the magnitude of the applied voltage. (Smith Pat., 15:41-42; emphasis added, 6-35; 17:1-23; Marom Decl., ¶ 64.) This linear proportionality is another way of describing a continuous, analog, relationship between the voltage driving the mirrors and the resulting mirror angle. (Marom Decl., ¶¶ 64-65.) The Smith Provisional also supports this disclosure:

> "[a]ccording to a preferred embodiment of the invention, the optical ***throughput of each wavelength channel may be controlled by using a mirror array with elements that can be rotated in an <u>analog fashion</u> about <u>two orthogonal axes</u>***. " Smith Prov., 6 (emphasis added); *see also id.*, 12:29-42, Fig. 9, 9:6-57, 10:37-43, 11:2-11, 14:49-65, 16:8-51.)

(a) Ground 2 – Bouevitch + Smith + Lin

Petitioner asserts that Ground 1 is sufficient for institution.

Bouevitch+Smith discloses all claimed elements, including the "continuously" limitation. Ground 2 adds one additional reference, Lin, to Ground 1 to further address the "continuously" term. If the Board decides that Bouevitch+Smith does not adequately disclose the "continuously" term, the Board should adopt Ground 2.

Under Ground 2, U.S. Patent No. 5,661,591 to Lin also teaches continuous, analog control of MEMS mirrors. (Ex. 1010, Fig. 3B; Marom Decl., ¶¶ 66-68.) As discussed below, it would be obvious to combine Lin's continuous, analog control with Bouevitch and Smith. For example, Figure 3B of Lin shows a graph disclosing the continuous deflection angle of MEMS mirrors as a function of the voltage applied to affect that deflection. Figure 3B shows the relationship as continuous and linear. (Ex. 1010, Fig. 3B).

To the degree the Board believes that "servo control assembly" requires an actuation mechanism, Lin also discloses the details of the actuation mechanism that the Lin patent uses to affect mirror deflection. (*See, e.g.*, Ex. 1010, 2:66-3:14.)

It also would have been obvious to substitute Smith's or Lin's continuous, analog, control into the Bouevitch ROADM. (Marom Decl., ¶ 67.) The PHOSITA would combine the teachings of these references at least for the reasons that (1) continuously controlled mirrors were known to be interchangeable with discrete-step mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and can more precisely match the optimal coupling value; and (3) Lin

specifically teaches that its analog, continuous MEMS mirrors would be useful in optical switching applications like Bouevitch's and Smith's ROADM devices. (Ex. 1010, 2:6-9; Marom Decl., ¶ 67.)

In addition, analog (continuous) control of the mirrors would be obvious to try because there are only two general options for such control—either analog (continuous) or discrete (step-wise) control. (*See* Marom Decl., ¶ 68.) For example, Lin discusses analog control as the alternative to binary (discrete) control of mirrors to increase the precision of the mirror placement. (Ex. 1010, 2:7-9; 3:41-57; Marom Decl., ¶ 70.) With only two options, both of which were known in the prior art, and both of which were suggested as working solutions for control, the PHOSITA would have expected that trying analog control would work well in the device of Bouevitch. (Marom Decl., ¶¶ 68-70.)

(b) "Pivotal about two axes"

Returning now to both Grounds 1 and 2, the only portion of the second part of element 1[d] not taught by Bouevitch is a micromirror "pivotal about two axes." But as previously discussed, Smith discloses such a micromirror. In particular, Smith describes a "multi-wavelength…optical switch including an array of mirrors tiltable about two axes, both to control the switching and to provide variable power transmission." Smith Pat., Abstract, 7:1-3, 7:32-44, Fig. 14, 8:19-20, 14:49-65; Marom Decl., ¶ 71.) Similarly, the Smith Provisional describes the use of two-axis

mirrors in its add/drop multiplexor (ADM) with pivoting in one axis to switch add/drop beams and in a second axis to control power. (Smith Prov., 6 ("each wavelength channel may be controlled by using a mirror array with elements that can be rotated in an analog fashion about two orthogonal axes."))

As discussed in § VIII.D, above, it would be obvious (and PHOSITA would be motivated) to exchange the 1-axis mirrors in Bouevitch with the 2-axis mirrors of Smith because the two types of mirrors were known to be interchangeable. The exchange would achieve benefits such as reduced device size (by eliminating gaps incorporated between ports to control attenuation) and allowing for no-crosstalk ('hitless') switching operation by moving the light beam to avoid intermediate fiber ports when switching. (Marom Decl., ¶¶ 72-73). As discussed below in § VIII.E.1(6), 2-axis mirrors also have benefits for power control, and as such would be obvious to use in ROADM applications where power control is important.

Replacing Bouevitch's 1-axis mirrors with Smith's 2-axis mirrors had the known benefit of minimizing the resulting device's size, which is desirable in optical devices. (Bouevitch, 2:9-21; Marom Decl., ¶ 73.) Size reduction results from "minimal spacing between crossconnect components," (Ex. 1006, 3:10-11), and PHOSITA knew that 2-axis mirrors allow for beam-steering between more compactly-spaced input/output ports arranged as a 2-D array. (Ex. 1009, 1:65-2:13.) The patentee itself acknowledged the benefit of 2-axis mirrors to steer

beams to ports arranged in a 2-D array. (‘678 Pat., 4:26-29; *see also* Marom Decl., ¶¶ 73-74.)

With respect to the last term of this portion of 1[d] (“to reflect corresponding received spectral channels into any selected ones of said output ports”), that term is merely an intended use, and should not be limiting, as discussed in the BRI section VII.B. In an abundance of caution, Petitioner addresses this use limitation. Both Bouevitch and Smith describe how the goal of controlling the MEMS mirrors is to effect the add/drop process, which includes reflecting the spectral channels to selected add/drop ports. (*See, e.g.*, Bouevitch, 14:66-15:18; Smith Pat., Fig. 5, 8:47-59, 12:4-12, 10:37-44; *see also* Smith Prov., 7; Marom Decl., ¶ 75.)

(6) Power Control using 2-Axis Mirrors

The third part of element 1[d] recites wherein each channel micromirror is controllable “to control the power of said received spectral channels coupled into said output ports.” As discussed in the BRI section VII.B, this statement of intended use should not be limiting in the first instance. Again, in an abundance of caution, Petitioner addresses this language.

Bouevitch discusses power control by tilting 1-axis mirrors to effect a slight misalignment between the beam and the output port. Bouevitch shows how each MEMS mirror controls the power of a “respective” channel, where “the degree of [power] attenuation is based on the degree of deflection provided by the reflector

(i.e., the angle of reflection)." (Ex. 1003, 1:24-27, 7:23-37.)

Smith discusses 2-axis (two dimensional) tilting for both switching and power control, including continuous control of such mirrors. The Smith Patent teaches a "two-dimensional array of two-axis tiltable mirrors." Smith Pat., 16:9-11.) Smith switches with mirror rotation in one axis, and control powers with mirror rotation in a second axis. The "principal switching operations us[e] the one mirror tilt axis," while "[t]he other mirror tilt axis, the minor axis, can be used for power adjustment." (*Id.*, 16:9-11, 34-51; *see also* Smith Prov., 6 ("Angular displacement in a first, switching plane, is used to perform an OXC, ADM or other switching function while angular displacement about the orthogonal axis is used for power control.").)

The PHOSITA would be motivated to use the 2-axis system of Smith within the system of Bouevitch for power control. (Marom Decl., ¶ 78.) First, power control was desirable generally and would be just as desirable after switching to 2-axis mirrors for the benefits cited in § VIII.E.1(5)above. Bouevitch notes both the desirability of power equalization across spectral channels, and the benefit of devices that perform both power control and add/drop functions. (Bouevitch, 1:18; 1:50-42.) Second, while power control in an axis orthogonal to the switching axis is not absolutely necessary, "second axis tilting is nonetheless desired for optimization." Smith Pat., 16:55-59.) Such tilting is useful because it allows

power control by moving a beam off-center of a port in an axis orthogonal to the switching axis without the risk of the signal bleeding into a port that is adjacent to the output port along the switching axis. (Marom Decl., ¶ 79; Smith Pat., 18:18-25; Smith Prov., 9-10.) Third, a separate axis for power control allows the use of finer-grained movement for power (which is more sensitive to small changes in mirror angle) than the coarser-grained control that accommodates the wider range of potential tilt angles for switching. (Smith Pat., 17:53-18:25, Marom Decl., ¶ 80.)

2. Claim 2

Claim 2 recites two elements: (1) "the wavelength-separating-routing apparatus of claim 1 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports," and (2) the use of that assembly "for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports." Element (1) will be referred to as the "servo control assembly" element, and element (2) as the "coupling" element. Each element is discussed in order, below.

Servo Control Assembly: As discussed in the BRI section, above, the BRI of a "servo-control assembly" is a "feedback-based control assembly." The '678 patent explains how its servo-control assembly measures output power of the spectral channels coupled into individual output ports, then uses that measurement

in a feedback loop to further adjust the mirrors to maintain a certain coupling efficiency and resulting output power. (*See* § VII.D; *see also* '678 Pat., 4:45-52.)

Smith discloses this servo control assembly in Fig. 8-Annotation 1, below, in the form of a "controller" ("B") that receives feedback from an "optical power monitor" ("A"). Specifically, Smith discloses a "microprocessor" that uses feedback of data from a power spectral monitor to generate signals to adjust the angles of individual micro-mirrors. (Smith Pat., 18:42-53, 13:20-24.) "FIG. 8 is a block diagram of an optical switching system including an optical power monitor and feedback control" Smith Pat., 8:2-4; *see also* Smith Prov., Fig. 4):

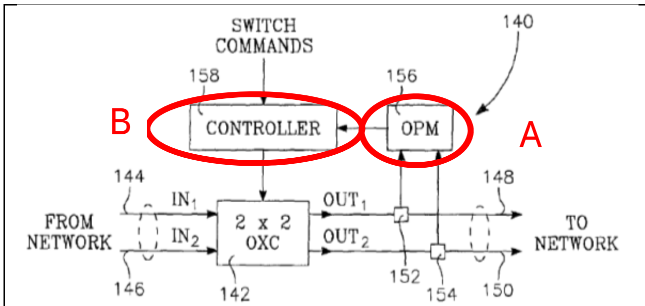
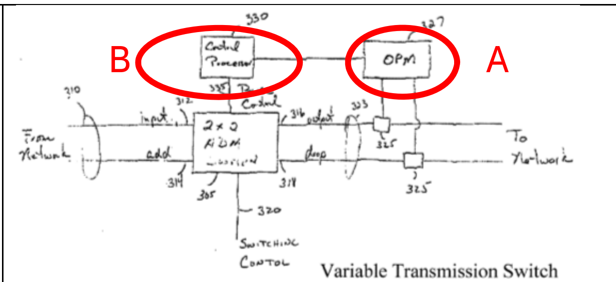


FIG. 8

Smith Pat., Fig. 8 (Annotation 1)



Variable Transmission Switch
Figure 4

Smith Prov., Fig. 4 (Annotation 1)

(*See also* Smith Pat., 18:42-53, 13:20-24, Fig. 12, 8:3-4, 9:29-10:13, 13:20-14:15; Smith Prov., 11 ("This resulting feedback loop may be used to actively optimize the power spectra of the signals leaving the ADM switch")).

It would be obvious to PHOSITA to try the internal feedback loop in Smith for use in Bouevitch as an alternative to the "external feedback" for power control that Bouevitch explains should be eliminated. (Ex. 1003, 10:17-21.) Internal

feedback is obvious because the only alternatives to provide such feedback would be the use of (1) internal or (2) external feedback. (Marom Decl., ¶¶ 84-85.) Using the Smith internal feedback technique to control coupling efficiency was known (*id.*), and one of skill would be motivated to do so to allow for the use of internal feedback to accurately respond to changing power levels. (*Id.*; *see also* '678 Pat., 12:9-15 (noting that the "algorithm/software for such processing unit in a servo-control system are known in the art."). It would also be obvious to use the various actuation mechanisms in Smith and Lin. (Smith Pat., 10:12-32; *see also* Smith Prov., Fig. 11; Ex. 1010, 2:66-3:38; Marom Decl., ¶ 92.))

Coupling: The second element of claim 2 recites the intended use of the servo control assembly "for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports." This element is merely an intended use, and should not be limiting, as discussed in the BRI section VII.B, above.

In an abundance of caution, Petitioner addresses this use limitation. As discussed immediately below, both Smith and Bouevitch describe how a goal of their respective servo control assemblies is to control the MEMS micromirrors to maintain a predetermined coupling of each mirror's spectral channel into an output port. (Marom Decl., ¶¶ 86-87.)

Smith discusses its use of servo-control to achieve a particular degree of

coupling of a channel to an output port. Smith discloses the use of "fine control along one or more minor axes…to moderate the degree of coupling of a wavelength channel," and shows at least two different types of coupling control in Figures 17 and 18. (Smith Pat., 7:32-44; 16:63-17:53("The fundamental control mechanism of the optical switches based on tilting mirrors is the degree of coupling between the free-space optical beams within the switch and the waveguides of the concentrator."); Marom Decl., ¶ 87; *see also* Smith Prov., 10, Fig. 4, 22:17-19.) This coupling angle must be predetermined because the coupling controls the power levels, which are themselves predetermined, as discussed in § VIII.E.4, below.

Similarly, Bouevitch discusses the use of MEMS mirrors for a Dynamic Gain Equalizer (DGE) function, in which output power is determined by the coupling angle of the light beams reflected from those mirrors to output ports. Bouevitch teaches that the coupling angle is predetermined in order to achieve a particular power level. Bouevitch states that "[e]ach sub-beam…is selectively reflected back to the spherical reflector **910** at a predetermined angle," by the modifying means [e.g., MEMS mirrors], and that "[v]ariable attenuation is provided by the modifying means." (Bouevitch, 12:55-59; *see also* Marom Decl., ¶ 88.) "The degree of attenuation is based on the degree of deflection provided by the reflector (i.e., the angle of reflection)." (Bouevitch, 7:35-37; Marom Decl., ¶¶

87-88.) The coupling angle created by that deflection is predetermined by the servo-control for the MEMS mirrors as that servo-control works to achieve a particular target power level by moving the mirrors. (*Id.*)

3. Claim 3

Claim 3 recites two concepts, "The wavelength-separating-routing apparatus of claim 2 wherein said servo-control assembly comprises:" (1) "a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports" and (2) "a processing unit responsive to said power levels for providing control of said channel micromirrors." Each concept is discussed below in turn.

As for the "spectral monitor" concept, the BRI for that term is "a device for measuring power." Smith discloses a "spectral monitor" as "optical power monitor (OPM) 156" at "A" in Figure 8-Annotation 1 (in § VIII.E.2, above) that measures power. (Bouevitch, 9:13–15) Smith's OPM 156 receives input from taps at 152 and 154. The OPM then provides optical power data to the controller 158 at "B". (Smith Pat., 13:20-24; *see also id.*, Figs. 8, 9, 12, 8:3-4, 9:29–10:21, 13:20-14:15, 9:42-49, 11:39-45; Smith Prov., 6, 11, Fig. 4; Marom Decl., ¶¶ 90-93.) Controller 158 in Fig. 8 serves as the processing unit and provides control over MEMS mirror tilting—adjusting the coupled output power on ports Out_1 and Out_2 by changing the tilt on the mirrors in the switch 142, thereby forming a feedback loop with the measurement apparatus. (Smith Pat., 9:29-33, Fig. 8, *see also id.,* 18:42-53.)

The intended use phrase for the spectral monitor: "for monitoring"—is non-limiting and need not be shown in the prior art. (§ VII.C) But in an abundance of caution, Petitioner addresses this phrase. Smith discloses that its spectral monitor is for monitoring the power of the optical outputs by tapping those outputs at taps 152 and 154. (*Id.* at Fig. 8-Annotation 1, 9:29-49; Smith Prov., 11, Fig. 4.)

As for the "processing unit," Smith discloses that unit as "220 CONT[roller]." Smith explains that its "controller controls the driver circuit and hence the mirrors in a multiplexed control system." (Smith Pat., 11:18-21, Fig. 13 ("220 CONT"); *see also* Smith Prov., Fig. 11, pp. 6, 11). Smith gives an example of the controller as a "microprocessor [that] reads the optimum position settings for both axes of both the input and output mirrors." (Smith Pat., 18:42-53.) Smith also uses its controller for power control in a feedback loop, as the controller "receives the outputs of the optical power monitor 218, or more specifically the detected optical intensities of the detector array, and accordingly readjusts the tilt positions of the micromirrors in the MEMS array." (*Id.*, 13:20-24; Fig. 8, 12, 8:3-4, 9:29-10:13, 13:20-14:15; Smith Prov., Figs. 4, 6; Marom Decl., ¶¶ 94-98.)

Addressing the intended use phrase for the processor, Smith also describes how its processor is "for providing control" of the mirrors by "readjust[ing] the tilt positions of the micromirrors in the MEMS array." (Smith Pat., 13:20-24, 18:42-53; Smith Prov., 10-11.)

As for obviousness to combine, it would be obvious to a PHOSITA to use Smith's spectral monitor (including its tapping of output port taps, *see* § VIII.E.10, below) and processing unit within the Bouevitch ROADM. (Marom Decl., ¶¶ 92, 95-99.) As the patentee stated in the '678 patent, a "skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application." ('678 Pat., 12:11-15.) Thus, the use of both a monitor and a processing element were simply applying known elements for their known purpose. The PHOSITA would also understand that the feedback from the monitor would need to be processed by a processor to turn the power measurement into control signals for the mirrors. (Marom Decl., ¶¶ 92, 95-99.) For example, the processor would need to determine the amount of tilt change required on the mirrors to adjust the power output, and feedback was necessary to adapt to varying power levels. (Marom Decl., ¶ 92; *see also* Ex. 1010, 2:66-3:38.)

The PHOSITA had ample motivation to combine the Smith feedback loop within Bouevitch because PHOSITA would appreciate that the feedback-driven control of Smith would improve the precision of the mirror-based switching system of Bouevitch. (Marom Decl., ¶ 92.) A contemporary document in the optical switching field demonstrates this motivation to combine, stating that "the actuation method for [micromirrors] is often imprecise. To achieve a variable switch, it is

typically necessary to use a very high level of optical feedback." (Ex. 1009, 2:4-9; *see also* Marom Decl., ¶ 92.) The use of a processing unit and a spectral monitor would also have been obvious because both were known elements with near-universal applicability in the field of configurable photonics, and the results of this combination would have been predictable. (Marom Decl., ¶¶ 94-95.)

4. Claim 4

Claim 4 recites "The wavelength-separating-routing apparatus of claim 3, wherein said servo-control assembly maintains said power levels at a predetermined value." The '678 patent gives an example of this power control as equalizing power at some desired level. ('678 Pat., 6:3-6.) Smith teaches "adjust[ing] the mirror positions to adjust the transmitted power to conform to one or more ***predetermined*** criteria." (Ex, 1004 at 11:48-51; emphasis added; *see also* Smith Prov., 4, 11, Fig. 10.) Smith discloses several such predetermined criteria, including a fixed, equal (and thus predetermined) power level for all channels, as well as a predetermined ("standard") set of levels for each channel. (Marom Decl., ¶100.) First, Smith discusses setting all channels to the same power level so that downstream components can depend on equal intensity channels. (Smith Pat., 9:59-10:13.) Second, Smith discusses setting the power of each individual channel power to a "standard" power spectrum to compensate for non-flat wavelength response of downstream components. (*Id*.) This standard spectrum requires

predetermined levels for each such channel. (*Id.*; Marom Decl., ¶ 100.) The Smith provisional teaches the same concepts. (Smith Prov., 4-5, 11, Fig. 10.)

It would have been obvious to try the predetermined power settings of Smith within Bouevitch, because there are only two classes of power settings to use: predetermined (e.g., from a power specification) and not-predetermined. (Marom Decl., ¶ 101.) And PHOSITA would have expected a likelihood of success using predetermined values based at least in part on Smith. (*Id.*) Smith teaches that predetermined power values could make up for inherent problems in optical switching, such as power variations from optical amplifiers and manufacturing and environmental variations, and because "WDM systems must maintain a significant degree of uniformity of power levels across the WDM spectrum." Smith Pat., 6:24-50; Marom Decl., ¶ 101.) In conclusion, Smith and Bouevitch are both WDM systems addressing similar power control problems, and are thus readily combinable regarding "predetermined" power.

5. Claim 9

Claim 9 recites "The wavelength-separating-routing apparatus of claim 1 wherein each channel micromirror is continuously pivotable about one axis." Bouevitch discusses micromirrors continuously pivotable about one axis. (Bouevitch, 14:5-65, 15:30-34.) So Bouevitch by itself discloses claim 9. Smith discloses mirrors that are continuously-pivotable in ***two*** axes under Grounds 1 and

2 (Bouevitch+Smith, and Bouvitch+Smith+Lin), and thus those same mirrors are also pivotable in ***one*** axis. (Smith Pat., Abstract, 7:1-44, Fig. 14 § VIII.E.1(5)(b); Marom Decl., ¶102.) And Bouevitch, Smith and Lin all disclose mirrors that are "continuously" pivotable. (Bouevitch, 7:35-37, 12:59-60; Smith Pat., 15:41-42; Ex. 1010, Fig. 3B, 2:66-3:14; § VIII.E.1(5).)

6. Claim 10

Claim 10 recites "The wavelength-separating-routing apparatus of claim 1 wherein each channel micromirror is continuously pivotable about two axes." Claim 1 recites the same limitation. Thus, claim 10 is obvious under Petitioner's Grounds 1 and 2 for the same reasons described for claim 1. (§ VIII.E.1(5); Smith Pat., Abstract, 7:1-3, 7:32-44, Fig. 14, 8:19-20, 14:49-65; Smith Prov., 6.)

7. Claim 13

Claim 13 recites "The wavelength-separating-routing apparatus of claim 1 wherein said fiber collimators are arranged in a one-dimensional array." Bouevitch shows a "front-end unit" arranged in a 1-D array in Figs 2a and 2b, and further discloses fiber collimators that are lined up to match that front-end unit, where the collimators are thus also arranged in a 1-D array. Specifically, Bouevitch describes how "light transmitted to and from the output and input optical waveguides is focused/collimated, e.g., through the use of microcollimators," and how these collimators can be configured to match a "front-

end unit (e.g., as shown in FIGS. 2a or 2b), which is in the form of an array [to couple] input/output waveguides." (Bouevitch, 13:9–18; Figs. 2a, 2b, 9b-9d; 5:22-42.) Thus, Bouevitch by itself teaches claim 13.

Smith also teaches arranging fiber collimators in a one-dimensional array, as shown circled below in figures 5 and 6 Smith Pat., Figs. 5, 6, 4:16-24; Smith Prov., Fig. 6):

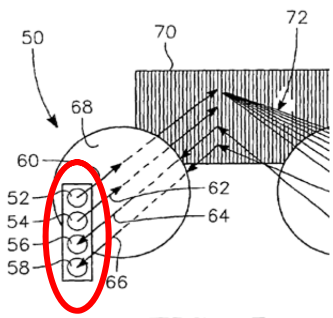


FIG. 5

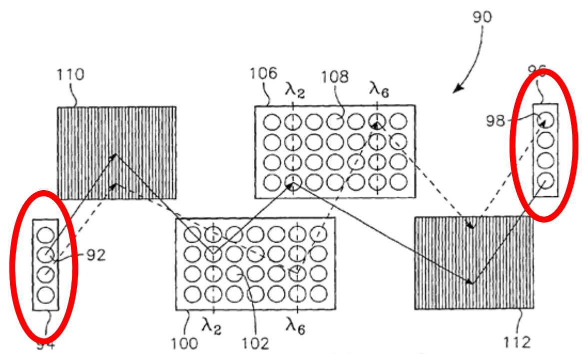


FIG. 6

It would be obvious to use Smith's 1-D array arrangement with Bouevitch to enable 'hitless'switching using Smith's 2-D mirrors, such that the beam moves off the array axis before moving between ports. (§ VIII.D, above; Marom Decl., ¶ 109.)

8. Claim 17—Grounds 1, 2, 3 and 4

Claim 17 recites "The wavelength-separating-routing apparatus of claim 1 wherein each said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings." Petitioner discusses below four separate grounds under which claim 17 is obvious.

Under Ground 1 (Bouevitch+Smith), Bouevitch discloses the claimed wavelength-selective element in the form of a dispersive grating. As discussed below, using the gratings of claim 17 was also obvious. (Marom Decl., ¶ 112.)

Under Ground 2, Petitioner adds Lin to Bouevitch+Smith, should the Board decide that Ground 1 does not disclose "continuously." (*See* ¶ VIII.E.1(5)(a), above) Because ground 2 includes Bouevitch, Claim 17 is obvious under Ground 2 for the same reasons as Ground 1.

Ground 3 is only necessary should the Board find that neither Grounds 1 nor 2 describe the "wavelength-selective device" of Claim 17. Under Ground 3 (Bouevitch+Smith+Dueck, also discussed below), Petitioner adds the Dueck reference to Ground 1 to further disclose "ruled diffraction gratings" and support the obviousness of using these gratings in the system of claim 17.

Under Ground 4, Petitioner adds Dueck to Ground 2. Claim 17 is obvious under Ground 4 (Bouevitch+Smith+Lin+Dueck) for the same reasons as Ground 3.

Returning now to Grounds 1 and 2, it would have been obvious under either ground to use any of the types of wavelength-selective devices recited in claim 17. Each type was known in the prior art, each was interchangeable as a wavelength-selective device, and each was one of a small set of possible choices. (Marom Decl., ¶ 112.) For example, Bouevitch discloses the use of dispersing gratings as wavelength-separating devices through Bouevitch's incorporation by reference of

Patent No. 5,414,540 ("Patel"). Patel notes that "frequency-dispersive mediums" include diffraction gratings. (Ex. 1031, 3:20-36 (included at Bouevitch, 1:37-39).)

Under Ground 3, it was obvious to combine Bouevitch+Smith with other teachings of specific types of wavelength-selective devices for WDM, including Dueck. Dueck discusses "ruled diffraction gratings." (Ex. 1021 (Dueck), 6:26-30; Marom Decl., ¶ 113.) It would be obvious to try Dueck's ruled diffraction gratings in the devices of Bouevitch and Smith. (*Id.*) The PHOSITA would be motivated to do so because Dueck describes its grating as part of the "best mode" of separating wavelengths in WDM devices, which include the Bouevitch & Smith devices. (*Id.*)

Similarly, under Ground 4, it was obvious to combine Bouevitch+Smith+Lin with Dueck for the same reasons given for Ground 3.

9. Claim 19

Claim 19 recites "The wavelength-separating-routing apparatus of claim 1 wherein each output port carries a single one of said spectral channels." As discussed in BRI § VII.B, this element should not be limiting. But even if it is limiting, Bouevitch discloses this limitation, because it describes dropping subset channel λ_2 from the combined set of channels λ_1 and λ_2, and then directing λ_2 out the OUT DROP output port, while only λ_1 is directed to a different output port called OUT EXPRESS. (Bouevitch, 14:27-15:18; §§ VIII.E.1(3), VIII.E.1(5).) Thus, each output port carries only one of the spectral channels.

10. Claim 20

Claim 20 recites "The wavelength-separating-routing apparatus of claim 19 further comprising one or more optical sensors, optically coupled to said output ports." Smith teaches that its optical sensor—an "OPM"—is optically coupled to output port taps. Specifically, "Power taps 152, 154 connected to the output ports OUT1, OUT2 divert a small amount of the optical power of the respective optical signals to an optical power monitor (OPM) 156 which measures the power of the optical signals**."** Smith Pat., 9:11-15 (emphasis original), 9:7-52; Smith Prov., 11.) Smith's "OPM" is shown at "A" in Figure 8-Annotation 1 (§ VIII.E.2, above). (Smith Pat., Fig. 8, 13:20-24; Figs. 9, 12, 8:3-4, 9:29-10:21, 13:20-14:15, 9:42-49, 11:39-45; Smith Prov., 6, 11, Fig. 4; Marom Decl., ¶ 116.)

It would be obvious to a PHOSITA to use Smith's optical sensor coupled to output ports for the same reasons that it was obvious to use Smith's spectral monitor and processing unit, as discussed in § VIII.E.3, above—e.g., increased accuracy for power control. (Marom Decl., ¶ 117.) PHOSITA would be motivated to exchange the sensor placement in Bouevitch with that of Smith because doing so would provide a more accurate measurement of the device's output power. (Marom Decl., ¶ 117.) Bouevitch's positioning of sensors behind its beam-folding mirror (prior to the output fibers) would provide less accurate measurements of the power levels in those fibers than Smith's sensors, which are optically coupled

directly to output port fiber. (*Id*.)

11. Claim 21

Claim 21 was not amended to narrow it to 2-axis mirrors. Claim 21 simply recites an array of micromirrors and an assortment of other limitations that are already addressed in this petition and obvious under Grounds 1-4. Thus, even references with 1-axis mirrors are sufficient to disclose the mirrors of claim 21.

(1) Preamble

The preamble to claim 21 recites "A servo-based optical apparatus comprising:" Because claim 2 recites a servo-based optical ***"wavelength-separating-routing"*** apparatus, the discussion above for claim 2 also covers the broader "servo-based ***optical*** apparatus" of claim 21, as an "optical" apparatus is broader than a WSR apparatus. Thus, the preamble for claim 21 is disclosed under the references of both Grounds 1 and 2 for the same reasons provide for claim 2. (*See* § VIII.E.2, above.)

(2) Claim element 21[a]-21(c)

The first three elements of claim 21 (recited as "[a]" to "[c]" in claim 21) are identical to elements [a]-[c] of claim 1. These elements are disclosed by Bouevitch for the same reasons set forth in claim 1. (§ VIII.E.1, above) To avoid unnecessary repetition, those arguments are not copied here. They are incorporated by reference. As in claim 1, Petitioner again points to Smith+Bouevitch under

Ground 1 as making claim 21 obvious. Because claim 1's "continuously" element is not recited in claim 21, Petitioner does not analyze claim 21 under Ground 2 of Smith+Bouevitch+Lin. The remaining elements of claim 21 are discussed below.

(3) Element 21[d]—array of controllable micromirrors

The fourth limitation to claim 21 recites "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said output ports[.]" The main substantive difference between element 21[d] and 1[d] is that the Patentee did not amend element 21[d] to narrow it to add that the mirrors are "pivotal about two axes" and to add the intended use term regarding power control as in 1[d]. Thus, element 21[d] is disclosed by Bouevitch even without Smith, because Bouevitch's ROADM uses individual control of MEMS mirrors with 1 axis of rotation for reflecting channels into output ports. (*E.g.*, Bouevitch, 14:14-15:18, 7:23-37.)

(4) Element 21[e]—servo-control

The fifth limitation of claim 21, identified here as 21[e], recites "a servo-control assembly, in communication with said channel micromirrors and said output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said output ports." Element 21[e] is substantively identical to apparatus claim 2 and is disclosed by the references described in each of Grounds

1 and 2 for the same reasons as for claim 2. (*See* § VIII.E.2; Marom Decl., ¶ 121.)

12. Claim 22

Claim 22 recites identical language to claim 3, and is thus obvious under each of Grounds 1 and 2 for the same reasons as for claim 3. (*See* § VIII.E.3)

13. Claim 23

Claim 23 recites "The servo-based optical apparatus of claim 22 wherein said servo-control assembly maintains said power levels at a predetermined value." Claim 23 recites identical claim language as apparatus claim 4, and is thus disclosed for the same reasons as for claim 4. (*See* § VIII.E.4.)

14. Claim 27

Claim 27 recites "The servo-based optical apparatus of claim 21 wherein each channel micromirror is continuously pivotable about at least one axis." Claim 27 recites identical claim language as apparatus claim 9 and is thus disclosed for the same reasons as for claim 9. (*See* §§ VIII.E.5, VIII.E.11(4))

15. Claim 29

Claim 29 recites identical claim language as apparatus claim 17 except for claim 29's recitation of dispersing "prisms" instead of "gratings." Thus, claim 29 is obvious under each of Grounds 1, 2, 3, & 4 for the same reasons as for claims 17 and 21. (*See* §§ VIII.E.8 & VIII.E.11.) For example, the Patel patent incorporated within Bouevitch notes that prisms are one type of "dispersive media." (Ex.

1031,3:20-36; (incorporated in Bouevitch, 1:37-39); Marom Decl., ¶ 126.)

16. Claim 44

Claim 44 is an independent claim that closely resembles claim 1. Elements [b] and [c] of claim 44 are identical to elements [b] and [c] of claim 1. These elements are disclosed in Bouevitch for the same reasons set forth in claim 1. (*See* § VIII.E.1(3).) The few differences between the other two claim elements of claim 44 (identified here as 44[a] and [d]) and claim 1 are small and also obvious under both of Petitioner's Grounds 1 and 2, as explained below. To the extent claim 44's preamble is limiting, it is also disclosed by the references of Grounds 1 and 2.

The only differences between elements 1[a] and 44[a] are the additional limitations in 44[a] of a pass-through port and at least one drop port, and that the collimators of 44[a] are part of "an array." The only difference between elements 1[d] and 44[d] is the pass-through port in 44[d] for receiving a subset of spectral channels. The references of Grounds 1 & 2 disclose all of these limitations.

(1) Preamble

The preamble to claim 44 recites "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes." Thus, claim 44's preamble simply embeds the use of the wavelength-separating-routing apparatus of claim 1 within a larger optical system. Such uses of WSR apparatuses are disclosed by Bouevitch and Smith,

each of which teaches using optical switches in a WDM system. (Bouevitch, 1:18-30; Smith Pat., 2:5-42, 6:65-57 ("It would be desirable to integrate the capability of such [crossconnect] systems into an optical network"); Smith Prov., 2; Marom Decl., ¶ 129.) The preamble of claim 44 is also obvious, because the point of using a ROADM/DGE is to use it within an optical network. (Marom Decl., ¶ 129.)

(2) Claim element 44[a]—fiber collimator ports: input, outputs, pass-through, and drops

The first limitation to claim 44 (identified here as 44[a]) recites "an array of fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports including a pass-through port and one or more drop ports[.]" Bouevitch discloses the use of collimators to provide all these ports.

In order to transmit light "to and from the output and input," Bouevitch discloses "the use of microcollimators," which the PHOSITA would recognize are types of fiber collimators. (Bouevitch, 13:9-13; Marom Decl., ¶¶ 130-131.) Bouevitch also discloses that the output port can be used as the pass-through port of element 44[a] when the "modifying means" of the Bouevitch's ROADM allows a light beam to pass through unchanged. (Bouevitch, 6:20–25; Marom Decl., ¶ 131). Bouevitch teaches another output port in the form of "OUT DROP" drop port in element 80b, port 3. (*See* annotation "D" in Fig. 11-Annotation 1, in § VIII.E.1(2), above.) Bouevitch also discloses additional output ports. (*Id.*, 10:56-

61 ("wherein each band has its own corresponding in/out/add/drop ports.") Each of these ports is provided by and comprised of microlens microcollimators. (Marom Decl., ¶ 131.)

(3) Element 44[d]—control power of spectral channels into output ports including a pass-through port

The fourth limitation to claim 44 recites "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels into said output ports, whereby said pass-through port receives a subset of said spectral channels." Other than the addition of "whereby said pass-through port receives a subset of said spectral channels," claim 44[d] is substantively identical to claim 1[d] and is obvious for the same reasons. (*See* § VIII.E.1(5).) As for element 44[d]'s "pass-through port," Bouevitch discloses this use of its pass-through port. Bouevitch gives an example where a subset of the spectral channels (channel λ_1) is passed through to the pass-through output port unchanged. (Bouevitch, 14:39–65; Marom Decl., ¶ 132.)

17. Claim 45

Claim 45 recites identical claim language as apparatus claim 2, and is thus

disclosed for the same reasons as for claim 2. (*See* § VIII.E.2.)

18. Claim 46

Claim 46 recites identical claim language as apparatus claim 3, and is thus disclosed for the same reasons as for claim 2. (*See* § VIII.E.3.)

19. Claim 53

Claim 53 recites identical claim language as claim 29, and is thus disclosed for the same reasons as for claim 29. (*See* § VIII.E.8.)

20. Claim 61

Claim 61 is a method claim version of claim 1 with no other substantive differences to claim 1 save replacing the claim term "individually and continuously controllable" of claim 1 with "***dynamically*** and continuously controlling." Claim 61 is otherwise broader than claim 1, lacking claim 1's "collimator" limitation.

(1) Preamble of claim 61

The preamble of claim 61 recites "A method of performing dynamic wavelength separating and routing." Bouevitch describes a method for wavelength separating & routing—specifically, a method for operating a device that separates (spatially disperses) a light beam according to wavelength and routes the separated sub-beam along a designated pathway. (Bouevitch, Abstract; *see also id.*, 2:28-31, 8:8–41; 5:15–20; 14:14-21; Figs. 1, 11; 3:9-63.) The "dynamic" portion of this preamble is also disclosed by Bouevitch and is discussed below for element 61[d]

at § VIII.E.20(5). As is the case for claims 1, 21 and 44, claim 61 is obvious under both Grounds 1 and 2. And Petitioner incorporates by reference its arguments for those claims here to avoid replication.

(2) Claim element 61[a]—receive signal from input

The first limitation to claim 61 recites "receiving a multi-wavelength optical signal from an input port[.]" Bouevitch describes this element by teaching how its ROADM operates to add/drop different wavelengths that are multiplexed together as received in the input port. (*See* Bouevitch, 1:18-30, 14:14-15:18; § VIII.E.1(2).)

(3) Element 61[b]—separating the multi-wavelength signal into spectral channels

The second limitation to claim 61 (61[b]) recites "separating said multi-wavelength optical signal into multiple spectral channels." Bouevitch discloses this step at Figure 11, where diffraction grating 20 spatially separates combined channels $\lambda_1\lambda_2$ ("A" at Fig. 11-Annotation 2, above) into spatially-separated channels. (*See, e.g.*, § VIII.E.1(3) (element 1[b]), above, Fig. 11-annotation 1 at "B", in § VIII.E.1(2); Bouevitch, 14:48-53, 8:10–22; Marom Decl., ¶ 140.)

(4) Element 61[c]—focus spectral channels onto array of beam-deflecting elements

Claim 61's third limitation (61[c]) is "focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels[.]" Bouevitch discloses

the recited "focusing" using reflector 10 in Figure 11-Annotation 2 at "R," (§ VIII.E.1(4), above), to focus each channel onto a corresponding beam deflecting element (mirror 51 or 52). (Bouevitch, Figs. 11, 6a, 15:7-11, 14:14-20, 48-55, Fig. 1, 8:46–49; *see also* Smith Pat., 12:43-50, Smith Prov., 7-8; Marom Decl., ¶ 141.)

(5) Element 61[d]—dynamically and continuously controlling direction and power of spectral channels

The fourth limitation to claim 61 recites "dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of said output ports and to control the power of the spectral channels coupled into said [sic] selected output ports." The BRI of controlling "in two dimensions" means controlling "in two axes." The BRI of "continuously controlling" is "under analog control."

The only substantive difference between claim 61[d] and claim 1[d] is the addition in 61[d] of "controlling ***dynamically*** and continuously." Thus, other than for "dynamically," the method step of claim 61[d] is obvious under each of Grounds 1 & 2 for the reasons discussed for claim 1[d], above. (*See* § VIII.E.1(5))

The plain and ordinary meaning of "dynamically" controlling in the context of the '678 patent is controlling "during operation." The patentee confirmed this meaning by contrasting "fixed" routing to "dynamic" routing: "the [prior art] wavelength routing is intrinsically static, rendering it difficult to dynamically

reconfigure these OADMs.”); ‘678 Pat., 3:22-23; Marom Decl., ¶¶ 142-144.)

Both Bouevitch and Smith teach “dynamic” control during the operation of their add/drop devices. (Marom Decl., ¶145.) Bouevitch discloses a “dynamic gain equalizer and/or configurable add/drop multiplexer,” which includes dynamic control of the mirrors that perform those actions. (Bouevitch, 2:24-25; Marom Decl., ¶ 145.) Smith notes that it “is well known” that power control “should be dynamic and under feedback control since the various wavelength components ***vary in intensity with time***.” Smith Pat., 6:37-50 (emphasis added); 2:23-31, 7:24-31.) The Smith Provisional also supports dynamic control, as is apparent from the fact that the Smith ROADM processes control signals/commands as it operates. (*See* Smith Prov., Figs. 11, 7; Marom Decl., ¶ 145.) Because Bouevitch by itself and also in combination with Smith both disclose dynamic control, claim 61 is obvious under each of Grounds 1 and 2, as both contain Bouevitch and Smith.

21. Claim 62

Claim 62 is a method version of apparatus claim 2, and recites “The method of claim 61 further comprising the step of providing feedback control of said beam-deflecting elements to maintain a predetermined coupling of each spectral channel directed into one of said output ports.” The only substantive difference between claim 62 and claim 2 is that claim 62 uses “feedback control” instead of a “servo-control assembly.” (*See* § VII.D, above.)

As discussed for claim 2 in § VIII.E.2, above, Smith discloses this feedback control in the form of a "controller" that receives feedback from an "optical power monitor." (Smith, 18:42-53, 8:2-4, 13:20-24, Fig. 12, 8:3-4, 9:29-10:13, 13:20-14:15; Smith Prov., Fig. 4, 11.)

22. Claim 63

Claim 63 is substantively identical to claim 4, reciting "The method of claim 62 further comprising the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining [sic:predetermined] value." Thus, claim 63 is obvious for the same reasons as for claim 4. (*See* § VIII.E.4).

23. Claim 64

Claim 64 is a method version of claim 19 and recites "The method of claim 61 wherein each spectral channel is directed into a separate output port." This one-channel-per-port scenario is merely a specific mode of the normal operation of the ROADM disclosed in Bouevitch, in which each channel happens to go to a different output port. Claim 19 equivalently recites "wherein each output port carries a single one of said spectral channels." Thus, claim 64 is obvious for the same reasons as for claim 19. (*See* § VIII.E.9; Marom Decl., ¶ 148.)

24. Claim 65

Claim 65 is similar to claim element 44[d], and recites "The method of claim

61 wherein a subset of said spectral channels is directed into one of said output ports, thereby providing one or more pass-through spectral channels." The last part of element 44[d] similarly recites "whereby said pass-through port receives a subset of said spectral channels." Thus, for the same reasons discussed above for Claim 44[d], claim 65 is obvious. (*See* § VIII.E.16(3)). Bouevitch also describes additional sets of output ports (pass-through and drop ports) in scenarios where the ROADM switches two sets of frequency bands. (Bouevitch, 10:56-61.)

IX. WRITTEN DESCRIPTION SUPPORT FOR THE SMITH PATENT'S SEPTEMBER 22, 2000, PRIORITY DATE

The Smith Patent is § 102(e) prior art as of the September 22, 2000, filing date of its corresponding provisional application, No. 60/234,683. (*See* § VIII.A, above.) As shown by Petitioner's parallel citations above to both the Smith Patent and Provisional, the Smith Provisional patent provides written description support for each aspect of the Smith Patent which Petitioner relies upon. (Marom Decl., ¶¶ 152-154.) To further confirm the Smith Patent's priority date, Dr. Marom analyzed each claimed feature of the claimed invention of the '678 patent and concluded that both the Smith Patent and the Smith Provisional disclose each such feature. (Marom Decl., ¶¶ 153-154.) As part of this analysis, Dr. Marom provides an element-by-element comparison of the Smith Provisional and the Smith Patent in chart form in his declaration. (Marom Decl., ¶ 154.)

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(b), the undersigned certifies that on July 15, 2014, a complete and entire electronic copy of this **Petition for Inter Partes Review No. 2014-01276**, including Exhibit Nos. 1001-1048 and a Power of Attorney, was served via USPS EXPRESS MAIL, costs prepaid, to the Patent Owner by serving the correspondence address of record as follows:

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